

Passing Big Bend and entering upon the lower division, the river widens and its fall decreases; numerous gravel bars and shoals are met with, which become more frequent in the lower part of the river.

The distance from Big Bend to the mouth of the river I estimate to be 41 miles, following the meanderings of the river, though in a direct line I do not think it will exceed 25 miles. The course of the river for the first 10 miles below Big Bend is nearly due south to its confluence with Illinois River, a tributary coming in from the left. From Illinois River, Rogue River follows for a short distance a general north-westerly course, turning then to the west and finally to the southwest, which general course it maintains until it reaches the Pacific Ocean. The river from the mouth of the Illinois is very crooked, the bends being very numerous and abrupt, and the intermediate straight parts being with few exceptions very short. The river has a width over nearly the whole distance from Big Bend to the ocean varying from 200 to 400 feet, except at a few of the rapids and swifts, where it narrows, and at and near the mouth of the river, where it widens to a maximum of but little over one-third of a mile. On this division I noted 31 rapids and swifts, but few of them, however, offering much impediment to the free navigation of the river for a distance of 35 miles from its mouth.

The foot-hills of the mountains are here cut through by the river, and the valley loses the cañon-like character which has been characteristic of the river above. Though as a rule the steep hillsides terminate abruptly on the edge of the river, and in some cases in perpendicular rock-bluffs, yet frequent short and narrow benches of arable land are met with. This character the river valley maintains with great uniformity until the head of tide water is reached, at a point 4 miles above its mouth.

The river has cut its way through beds of indurated clay-rock, interspersed with occasional beds of sandstone. At places it is shoaled or narrowed by extensive gravel-bars. The fall of the river will not exceed an average of more than 2 or 3 feet per mile, being greatest at the upper end of the division.

The part of Rogue River Valley immediately adjoining the river, and which has been the subject of this examination, is but little settled, the land being as a rule very rocky, and offering but little inducement to the settlers. In the Upper Valley, or that part lying east of the Rogue River Mountains, the principal settlements lie some distance to the south of the river, on Big Butte, Dead Indian, Bear, Applegate, and other creeks tributary to the Rogue River. This country is very productive in all kinds of agricultural produce, in hogs, cattle, and sheep. Prices of all kinds of domestic produce are very low, the facility for transportation beyond the basin being very limited and the cost high, surrounded as it is on all sides by high mountain ranges. The timber of the country is principally white and yellow pine, with occasional groves of fir-trees and white and black oak. The level part of that part of the valley adjoining the river is generally prairie land, with occasional scattered black pine and black and white oak of stunted growth. Near the base of the hills and up the slopes to the summits the surface is covered with a light growth of pine timber, with many areas of bald surface. The surface is free from underbrush, and the timber nowhere so dense as to prevent the growth of the native grasses. Beyond the summits of the hills which flank the valley the timber is said to be much better in quality and to be found in larger quantities.

This basis has for many years produced large quantities of gold from placer mines on the banks of the river, and in and adjacent to the beds of the streams which traverse the country. Many of these mines are now being worked on an extensive scale. When water is abundant, the river-banks and the small tributaries afford mining ground for many small companies of miners, many of whom are Chinamen.

Considering the capacity of this country to sustain a large population, it is very thinly settled. This is mainly due to the absence of a market for the surplus products which could be raised there. When it is possible to furnish an outlet that will afford cheap facilities for the exportation of the produce of the valley to a market, the country will furnish homes for a large and industrious agricultural population.

The mountain division of the river, passing as it does through high and lofty mountains, furnishes no agricultural lands, except a limited area among the foothills of the eastern slope. A few farmers have located on the isolated areas of arable lands, which they use principally for grazing purposes. The more mountainous parts of this division are uninhabited, except by miners on the river and its tributaries, and occasionally by a solitary sheep-herder, who grazes his flocks on the high, bald hills which are found in the deep recesses of the mountains at "Big Meadows" and "Little Meadows." These districts, adjoining each other, are situated in the heart of the mountains, and contain extended areas of high, bald hills, covered with grass. These hills rise to an altitude of from 2,000 to 3,000 feet. The district occupies a distance of 10 miles on the north side of the river, and extends northerly a distance varying from 5 to 10 miles. It is accessible only by mountain trails, crossing high mountain ridges which surround it on all sides, its accessibility by the river being blocked by the numerous close cañons or rock bluffs with which the river abounds.

Along the banks of the river I found many miners' cabins, and evidence on the bars and rocky banks of the river of recent mining operations, and in a few cases of quite extensive hydraulic mines. Owing to the scarcity of water at the time of passing down the river, but little mining was being carried on and that principally by Chinamen. When water is abundant for mining purposes, the gold mining carried on at many places on this part of the river and on its tributaries is very extensive. The principal mines are located at Spanish Gulch and at Galice Creek, on the eastern slope of the mountains. Many small companies of miners, however, mine on a small scale along this entire division.

On the mountain slopes of the eastern foothills are large forests of timber, principally pine. Oak timber is found in considerable quantities, while fir is quite scarce. The owners of the saw-mill at Ellensburg, at the mouth of the river, have for a number of years cut from the timbered lands of this section quantities of sugar-pine, and endeavored to drive it down to their mill. They have, however, signally failed in getting many of the logs lodged in their boom at the mill, as they would either land on the bars and among the rocks of the rapids in their descent, remaining there until the next freshet would carry them with uncontrollable velocity down the river and past the mill into the ocean. The last cut, consisting of 750,000 feet, was made in the spring of last year. None of these logs have yet reached the mill, but are to be found scattered along the river from where they were dumped into the river down to Big Bend.

From Big Bend to the head of tide-water, 4 miles above the mouth of the river, the valley is occupied by a few settlers, many of them half-breed Indians, whose houses are scattered at long intervals, occupying most of the available bottom and bench lands near the river. Back from the river and in the smaller valleys shedding into the river, as well as up to the slopes of the flanking hills an occasional settlement is found. The population occupying this part of the valley are generally old settlers or their children, who have been located here from the time of the early pioneering days. Their manner of living is generally rude and primitive, and but few of the luxuries, or refinements, or even comforts of civilization have yet found their way among them.

Wherever land is found fit for cultivation it produces abundantly of all manner of fruit and vegetables, and of excellent quality. The less hardy fruits or vegetables which, in the northern part of Oregon, will not stand the more severe climate, grow to great perfection here. But little grain is raised, and this, together with the other products of the soil, is consumed at home. A principal occupation of the settlers is the raising of sheep and cattle, of which large herds are grazed on the slopes of the valley and on the bald hills. For this the country is well adapted, as the bald hills, covered with nutritious grasses, extend for many miles on each side of the river.

Gold-mining is carried on at a few places on the gravel-bars when the supply of water will admit of it. As a rule, however, it does not pay. Ledges of native copper and of other copper ores and of chrome ore have been found on Illinois River, and on Rogue River, below the mouth of the Illinois. Their value as mining-property is little known, as no systematic or intelligent examination of them has been made.

Large quantities of very valuable timber are found growing among the western foothills of the mountains. Immediately adjoining the river, and extending back a short distance, the fir timber is of poor quality. Among the oaks, which are numerous in the valley, are found the white and black oaks of Oregon, and three evergreen varieties, designated by the inhabitants as "live-oak." Other varieties of timber of large growth, which in time will be of value, are found in the valley. Pine and cedar are found only in limited quantity.

The country adjacent to the last 4 miles of the river partakes less of the mountainous character than that lying to the east of it. The hills are, however, high, but their slopes more gentle; much less timber is found on them. The proximity to the sea affects the climate in such a manner that fruit and the more tender agricultural products do not thrive. The best of this country is used as pasture-land.

At the time of making the examination of the river the water was at its lowest stage, a long period of dry and frosty weather having preceded the period of my examination. The river generally reaches its lowest stage in the month of September, fluctuates a little during the fall until December or January, when a rapid rise takes place, the high-water continuing, however, only for a short period, after which it falls rapidly at first, and then more slowly, continuing its fall with many fluctuations until the low stage in September.

The winter rise is generally very great, the usual rise at this period in the upper part of the river, east of the Coast Range, being from 30 to 40 feet, while above the gorges in the mountains it is backed up to a much greater height, reaching in some cases as high as 70 feet. In the winter of 1861-'62, after a deep snow, which was followed by a warm rain, the rise of the river was unusually high, and flooded the bench-land adjoining the river, carrying away many buildings.

During the prevalence of these freshets all the rapids and falls of the river are lost sight of, and the river assumes the character of a boiling, surging mountain torrent, filled with strong eddies and whirlpools, and carrying down with it immense quantities of drift-wood to the ocean.

The volume of water passing down the river at its entrance into the mountains at the low stage of water at the time of the examination I estimated to be from 350,000 to 375,000 cubic feet per minute. This is increased by the tributary streams to a volume approximately estimated at 500,000 cubic feet at the mouth of the river.

The harbor at the mouth of the river is but little over a half mile in length, with an average width of a half mile, and has an area of 200 to 250 acres.

At the mouth of the harbor the channel is contracted to a width of 400 feet and confined by sand-spits jutting out from the beach on both sides. The submerged beach of the harbor falls off very gently from the shore-line to the middle of the harbor, where the greatest depth at low-water is 15 feet. The beach at the upper part of the harbor, lying at the base of the low hills, is narrow and low and sandy. This beach widens out at the lower end of the harbor, and connects with the wide and low sandy beach of the Pacific Ocean, throwing out the low sand-spits which contract the channel at the entrance of the harbor.

Passing out of the harbor through the narrow channel, the current is abruptly deflected to the south by a sand-bar and spit jutting out from the north shore. From here the channel follows a course nearly parallel to the ocean-beach for a distance of a quarter of a mile, and then crosses the bar diagonally into the open sea, which it reaches at a distance of a half mile from the narrows at the entrance to the harbor. The harbor is marked by no prominent headland, the hills near the ocean at its entrance being low and rolling. The harbor and its entrance are entirely free from submerged rocks that would obstruct the free navigation of the port, the bottom being throughout of sand, shifting under the varying influences of the currents. The sand-bar outside of the harbor is narrow, and the channel through it straight. The greatest depth upon it at low-water is 6 feet. The rise and fall of the tide is but 6 feet, thus affording a depth of channel of 12 feet upon it at high-water.

At the time of the annual freshets the strong current of Rogue River carries away the sand-spit opposite the entrance to the harbor, and opens a straight and direct channel to the sea. This channel, at times, forms near the north margin of the harbor, and at other times near the south margin, or at points intermediate. After the falling of the water, however, the strong northwesterly wind, which prevails during the summer season, throws a bar and sand-spit across the newly-made channel, gradually deflecting it to the south, until it again runs parallel to the ocean-beach.

During the past two years but one vessel, the steamer Alexander Duncan, has entered or left the port. This steamer is owned by Messrs. R. D. Hume & Co., the owners of the salmon-cannery and of the saw-mill and store at Ellensburg, and is run principally in the interests of their business on the river. The vessel has a registered tonnage of 148 tons, draws 9 feet of water, and has thus far had good success in crossing the bar opposite the entrance to the harbor. In the past two years she has averaged one round trip per month between San Francisco and this port. Other small steamers have in former years entered the harbor; the largest of these, the steamer Coquille, 164 tons register, carried a draft of 9 feet. In the earlier days the lumber trade of the port was carried on in small schooners of from 30 to 90 tons burden; at times they experienced great difficulty in crossing the bar, unless under favorable circumstances of wind and water.

The highest point of the river reached by any sea-going vessel is about 2 miles above its mouth, where is located a fish-packing establishment (now out of use).

No vessels bringing merchandise from foreign ports have entered this harbor, and it has therefore yielded no revenue from foreign imports. For a number of years a deputy collector of the port was stationed here, but the office was a few years ago abolished.

During the year 1878 there was landed at the port general merchandise, principally for domestic consumption, amounting in value to \$41,000. Of this, merchandise to the amount of \$35,000 was imported by Messrs. R. D. Hume & Co., and the remainder, \$6,000, by all others.

The exports during the same period consisted of salmon, wool, hides, and skins, and from \$1,500 to \$2,000 in gold dust, amounting in the aggregate to \$61,000. The entire trade of the port is carried on with San Francisco.

The principal part of the town of Ellensburg is situated on the left bank of the river at the head of the harbor and about half a mile from the ocean. From here a few houses are scattered at intervals down the shore of the harbor and on the ocean-beach for a distance of about three-quarters of a mile. The present population of the town will not exceed 100. The county-seat of Curry County is located here. Messrs. R. D. Hume & Co. carry on a salmon fishery and cannery, the principal industry of the place. This firm are also owners of the saw-mill located here, capable of cutting from 15,000 to 20,000 feet of lumber daily. For the past two years, however, the mill

has been in operation only to supply the very small demand of the neighborhood, and has been entirely idle since last July. The buildings of the town are: the saw-mill, the salmon cannery, a general-merchandise store, a hotel, a county building, 4 store buildings (at present unoccupied as such), a school-house, and about 25 dwellings. The buildings are all constructed of wood and in a very rude manner.

The valuable agricultural country adjoining that part of the river east of the Coast Range would be greatly benefited by an outlet for produce of the country; with such an outlet the population of the country and its industries would rapidly increase. The channel of Rogue River, by reason of its ruggedness and forbidding character, at once bars egress from the upper valley by the navigation of that river, the construction of works to admit of its navigation being utterly impracticable, if not impossible.

Below this country and as far as the ocean there is nothing in the country to warrant the expenditure of any money for improvements of the river. The character and population of the country are such that I am of the opinion that were the river now open to free and unobstructed navigation, the country west of the eastern base of the Coast Range would offer no inducements whatever to its navigation by steamers.

The subject of building a narrow-gauge railroad from the upper valley to a seaport is now being agitated by the residents of the agricultural basin east of the mountains. It is designed to avoid the mountainous part of Rogue River Valley by striking the headwaters of the Illinois River and descending that river to its confluence with Rogue River. Should the hopes of the projectors be realized it may be important at a future day, in order to make connection with the ocean by river, to open up to navigation that part of the Rogue River below the mouth of the Illinois. This part of the river, with the addition of a length of 4 miles above the mouth of the Illinois, is the only part of the river that can be made navigable without artificial lifts for light-draft steamers. At the head of this section and 35 miles from the sea is a shoal rapid 1,500 feet long and from 300 to 600 feet wide, falling 10 feet. Here the water passes over a bed of indurated clay rock.

Among the rapids, swifts, and shoals noted below the mouth of the Illinois, and numbering twenty-two at the low stage of water, but five of them will call for any work whereby the river will be rendered navigable for steamers of 3 feet draft at low-water. Two of these will require the removal of 260 cubic yards of rock and 100 cubic yards of gravel which obstruct the channel. At two places the river is confined to narrow channels, close under the left bank, by wide-exposed gravel bars on the left, while at the foot of these channels are very abrupt bends to the left, the current of the river concentrating in the bends. To render these parts of the river navigable will require in each case the construction of a channel through the gravel-bars on the left and of wing-dams at the head of the bars, to divert the current from the old channel. This will involve the removal, in the two cases, of 9,000 cubic yards of gravel, and the construction of 700 linear feet of wing-dam. The lowest obstruction consists in a short and wide gravel shoal, requiring the removal of 1,200 cubic yards of gravel and the construction of 200 feet of wing-dam.

The cost of this improvement I estimate as follows:

260 cubic yards rock, at \$25 .....	\$6,500
10,300 cubic yards gravel, at \$1 .....	10,300
900 linear feet wing-dam, at \$2 .....	1,800
	18,600

Very respectfully, your obedient servant,

PHILIP G. EASTWICK.

Col. G. L. GILLESPIE,  
Corps of Engineers, U. S. A.

K K 21.

SURVEY OF BAR AT MOUTH OF COLUMBIA RIVER, OREGON.

OFFICE OF THE CHIEF OF ENGINEERS,  
Washington, January 22, 1879.

SIR: I have the honor to submit herewith two copies of a report to this office from Maj. G. L. Gillespie, Corps of Engineers, of the result of a survey of the bar at the mouth of Columbia River, Oregon, made by Lieut. A. H. Payson, Corps of Engineers, to comply with so much of the river and harbor act of June 18, 1878, as required "a thorough survey

of the bar at the mouth of said river, and the preparation of a plan and estimates for its permanent improvement."

The survey is completed as far as necessary to establish the conditions of the channels and bar as then existing, but as a prolonged and careful study of those conditions as affecting the character of the harbor is necessary in order to determine what artificial means may be requisite to maintain a permanent channel across the bar, I concur with Major Gillespie's recommendation that the sum of \$5,000 be appropriated for the continuation of this survey and for further observations upon the currents at the entrance to the river, and beg to suggest that the report be sent to Congress for the information of the Committees on Commerce of the Senate and House of Representatives.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,

*Brigadier-General and Chief of Engineers.*

Hon. GEO. W. McCRARY,  
*Secretary of War.*

REPORT OF MAJOR G. L. GILLESPIE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,  
*Portland, Oreg., December 18, 1878.*

GENERAL: I have the honor to forward herewith my report on the survey of the bar at the mouth of the Columbia River, Oregon, made in compliance with the requirements of the river and harbor act approved June 18, 1878.

This survey was intrusted to the charge of my predecessor, Maj. J. M. Wilson, Corps of Engineers, and was conducted in person by Lieut. A. H. Payson, Corps of Engineers, who was, by a telegraphic order from the Chief of Engineers, dated August 15, 1878, temporarily detached from the orders of Lieut. Col. C. S. Stewart, Corps of Engineers, at San Francisco, and assigned to this district for that purpose.

On relieving Major Wilson, in compliance with Special Orders No. 193, paragraph 3 current series, Headquarters of the Army, Adjutant-General's Office, the duty of submitting plans and estimates for the permanent improvement of the bar devolved upon me. The able and comprehensive report of Lieutenant Payson for the survey of the mouth and bar of the Columbia River, to which is appended a supplementary report on the current observations, taken in both north and south channels and inside of the river's mouth, gives a summary of the changes which have occurred since the survey of 1869 by the United States Coast Survey, and enables one to form a very clear conception of the condition of the river's mouth and bar at the present time, and to judge approximately of the forces at work there tending to disturb the relations between the two channels through the outer bar, to modify their depths and directions, and to distort the form and positions of the inner-lying shoals.

The entrance to the river's mouth from the sea is virtually 6 miles wide, extending from Cape Hancock, or Disappointment, on the north shore, to Point Adams on the south. The whole area comprised between these points, however, is not available for navigation; from the former, a shoal makes out to the southwest, forming what is called the North Breakers, or Peacock Spit; and from the latter, a shoal toward the northwest, forming Clatsop Spit; between these two shoals, and lying somewhat inside of them, is a constantly-shifting sand island, which is at the

present time nearly  $1\frac{1}{2}$  miles in length by from 1,000 to 1,200 feet in width. From the western end of this island the submerged bank, known as the Middle Sands, extends within the 3-foot curve, in a direction a little south of west for nearly 4 miles, and thence runs south for an equal distance parallel to and overlapping Clatsop Spit. The girdle of submerged sands in front of the river's mouth is crossed by two channels leading into the river; one passing north of the Middle Sands, and called the "North Channel"; and the other passing south of the Middle Sands, and called the "South Channel."

These channels unite east of the eastern end of Sand Island. The North Channel is wide, deep, and straight in its outer part, and has 23 feet at low-water on the bar, but on the inside near its union with the South Channel, there is a bad shoal about half a mile wide, with only 16 to 17 feet water upon it. The South Channel, though shoaler and more tortuous than the former in its outer reach, is yet the one principally used by shipping at the present time. This preference is due in part to the protection and cover given to its entrance by the Middle Sands, and to its being the more direct and convenient route for vessels making the harbor from the south. It has at mean low-water a depth of 20 feet on the bar, though the tides sometimes reduce this depth by 1 or 2 feet, and a minimum width, between the 18-foot curves, of about three-fourths of a nautical mile. During ordinary weather, then, the bar can be conveniently crossed at mean low-water by vessels drawing not to exceed 20 feet, a depth which is rarely exceeded by the shipping of the port.

The outer harbor, however, is particularly sensitive to high winds and their consequent seas, and there are times when sailing-vessels are detained in port, or at sea, for several weeks, waiting for the sea to grow sufficiently calm on the bar to enable them to cross. Steam-vessels are not so much embarrassed by this state of affairs, and their detention is seldom protracted beyond one or two days. From early autumn to spring shipping has its most trying experiences in entering or leaving the harbor. During this period strong southerly winds prevail all the time, and the waves break heavily upon the coast, almost normal to the line connecting Cape Hancock with Point Adams.

In connection with the survey, I have had prepared, and submit with this report, an outline tracing of the harbor, showing in differently colored lines the shore-lines of the capes and of the mid-channel shoals, so as to present at a glance the changes which have occurred since the survey of 1869 by the United States Coast Survey. These changes, which are noted in detail in the report of Lieutenant Payson, are brought out clearly on an examination of the tracing, and one cannot fail to be impressed with the conviction that a new channel is preparing to be opened across the Middle Sands a short distance west of the western extremity of Sand Island. The depression in the sands which indicates the direction of the prospective new channel, has already been used for sometime by vessels during favorable winds and tides, both for entering direct and for passing from the North Channel into the South Channel, and the precipitous slope on the seaward side and the very diminished distance across the sands between the 18-foot curves are strong indications of an early decline of the old channels and the inauguration of a new, deep, and direct channel midway between them.

The bad shoal at the inner end of the North Channel almost completely closes that channel for deep-draught vessels, except under the most favorable conditions of wind and tide. The shoaling of the South Channel and the contractions of its outer part by the southward exten-

sion and eastward advance of the Middle Sands, while not materially interfering with its present efficiency, still draws our attention to the accumulating strength of the sand girdle at this point, and invites us to look elsewhere for a point of weakness already developed or developing under the demands of the river for an outlet for its own waters, supplemented by the action of the waves and tides of the sea. Even if the new channel is opened the benefits accruing therefrom will, it is thought, remain unimpaired only for a short period of time, for the bar is of pure sand, which continually shifts under prevailing winds and seas, advancing in one direction, throwing wavelets of sand into the open channels, reducing their depth, at the same time receding and diminishing in depth in another direction.

Such is the condition of the harbor at the present time, and if we review its history from the beginning of the century, when the first examination was made, we shall find the same forces at work, operating in the same way and repeating the same cyclical changes. Here I desire to express my acknowledgments to Prof. George Davidson, of the United States Coast Survey, for the valuable information he has gathered on this subject.

The earliest reliable survey of the entrance to the river was made in 1792 under the orders of Admiral Vancouver of the English Navy. At that time but one channel existed; it was 6 miles long from the outer 5-fathom curve to a long line joining Point Adams and the cape, was located on the north side of the entrance,  $1\frac{1}{2}$  miles south of Cape Disappointment, was  $1\frac{1}{2}$  miles wide, and had not less than 4 fathoms of water. Chinook Spit stretched nearly straight from about a mile east of the cape to Chinook Point. In the space inclosed by the three lines joining Cape Disappointment, Point Adams, and Chinook Point 5 fathoms was the least found, and the deepest water after crossing the bar was under the north shore eastward of Chinook Point.

#### BRITISH ADMIRALTY SURVEY IN 1839.

The next examination was made by Sir Edward Belcher in 1839. The Sand Island of to-day, and its companion, the Middle Sands, bare at low water, with its covering of snags and trees, is mentioned for the first time. It was  $1\frac{1}{2}$  miles long, covering about 4 square miles, and lay within the area said to have given 5 fathoms water in 1792. Deep water was found at its eastern end. Two channels were formed by the waters of the river passing on either side of the obstructions, the north channel affording the best water. This latter channel was separated from Baker's Bay by a middle ground. Chinook Spit, as connected with Chinook Point, did not exist. The western part of Clatsop Spit had been cut away to a distance of 3 miles, and a channel opened along Clatsop Beach and South Shore, and the north breakers had advanced  $1\frac{1}{2}$  miles to the southward nearly across the channel of 1792.

At the time of the survey of the United States exploring expedition of 1841 but one channel across the bar existed. The accretions to Clatsop Spit on the west side had practically closed the south channel of 1839. The north channel had changed but little, had 6 feet more water than the south channel, and retained within the cape its former shape and direction. The shape and position of the Middle Sands were nearly the same, but the east end had been moved nearly half a mile to the north-west, while the west end remained unchanged.

The United States Coast Survey made its first examination in 1850. Again there were two channels. Clatsop Spit, which in 1841 stretched

6 miles westward of Point Adams, had been cut through midway between the point and its western extremity by a wide channel, with 17 to 18 feet of water, running south by west from Sand Island, or at right angles with the corresponding channel of 1841. The north channel had changed but little, and had still over a fathom more water than the south channel. It had moved to the southward, its southern part cutting away over a mile of the west end of the South Sands of 1841. Inside the cape it had retained its direction of 1841, but had contracted somewhat. The Middle Sands had very much changed, but the northern part was similar to that of the previous surveys. The eastern part had moved north-northwest three-quarters of a mile since 1841. Sand Island had much increased in size, and had apparently moved with it. The western end of the great middle shoal eastward of Point Adams had been cut away three-quarters of a mile, and Clatsop Spit had made out from Point Adams in a northwesterly direction for over a mile.

The second examination by the Coast Survey was made in 1852. The following changes since 1850 were noticed: The new South Channel had been fully cut out and the bar had moved three-quarters of a mile eastward, with a wider entrance and three feet more water. The North Channel was contracted to half its width at the bar with its northern line on the line of 1850. The depth was reduced, but there was still over one fathom more water than on the South Bar. The channel was not so straight as in 1850; and a south channel had formed southward of the cape across the north breakers. Chinook Spit had commenced to reform. The Middle Sands had increased in size, and Sand Island had moved to the west-northwest over a quarter of a mile, giving 8 fathoms of water where the beacon of 1850 stood.

Compared with the surveys of 1839 and 1841, we find that one part of Sand Island retained the same position, but that a portion, one mile in extent, stretching east by south half south, had been completely cut away and was crossed by the South Channel. Clatsop Spit had changed its shape and extended westward. The western end of Middle Shoal east of Point Adams had not changed. The course in over the bar, through the South Channel, was straight for over 6 miles, until abreast of Point Adams, and then followed that of 1839. No resurvey was made until 1868, but it is known that early in 1857 the west end of the Middle Sands had swung around to the southward so as to throw the South Channel within less than a mile of the beach south of Point Adams, and in October of that year that the South Channel had completely closed, while the North Channel had remained wide and straight.

The third examination by the Coast Survey was made in 1868, and extended from the 15-fathom curve outside the bar to "Three Trees" Point, off Woody Island, in the Columbia River, a distance of about 23 miles.

The following changes were developed: The South Channel had reopened with a fathom more water than in the North Channel; the new channel was over 2 miles wide between the south point of the Middle Sands and the southwest side of Clatsop Spit, and had over 4 fathoms in it. The North Channel was narrower, but held pretty much the same position as in 1857, and had  $3\frac{1}{2}$  fathoms of water. The north breakers extended  $2\frac{3}{4}$  miles south-southwest from Cape Disappointment;  $1\frac{3}{4}$  miles of this distance had less than 12 feet of water; and for five-eighths of a mile they were dry at low-water. Sand Island was found to have separated into two parts, each three-fourths of a mile in length; the easternmost part lying east northeast and west-southwest, and the westernmost part north-northeast and south-southwest. At low-water both parts were